

The Impact of Leadership and Communication on Safety Culture Maturity Level

Natasya Andelia[1], Gerry Silaban[1], Isyatun Mardhiyah Syahri[1]
[1]Faculty of Public Health, Universitas Sumatera Utara, Medan

Email corespondence: natasyaandelia@gmail.com

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Abstract

Safety culture is the way workers behave safely when working without supervision. In addition, five levels categorized into pathological, reactive, calculative, proactive, and generative levels are used to evaluate the level of safety culture maturity. This research aims to determine the influence of leadership and communication on the level of maturity of safety culture at the State Electricity Company Project Management Center-Construction Management Implementation Unit IV. The type of research used in this research is quantitative research with a cross sectional research design. The research will be carried out at the limited liability company national electricity company project management center-construction management implementation unit IV which operates in the field of construction management services. The research was conducted from March to August 2023. The sample collection technique was total sampling. The research sample was 71 respondents. The research instrument used was a questionnaire. Data analysis using SEM-PLS or Partial Least Square- Structural Equation Modeling analysis using SmartPLS software. The research results show that leadership has a significant effect on the level of safety culture maturity (p value < 0.05), and communication has a significant effect on the level of safety culture maturity (p value < 0.05). Leadership and communication simultaneously have a significant influence on the level of safety culture maturity, with a combined contribution of 70.7% from these two variables. Meanwhile, the rest is influenced by other variables not examined in this research.

Keyword: Communication, Leadership, Safety culture maturity level

INTRODUCTION

The application of a safety culture in every workplace is always the main theme that is introduced at the annual national occupational safety and health Month commemoration in Indonesia, which is one of the many socialized and driven efforts to develop a safety culture. The company is obligated to implement occupational health and safety management system or an equivalent safety system in order to raise awareness and promote the development of a safety culture in every workplace (Wardhani, 2017).

Occupational safety and health is an effort to create a safe, comfortable working atmosphere, and the ultimate goal is to achieve the highest productivity. Therefore, occupational safety and health must be implemented in every type of work field without exception. Work safety and health efforts are expected to prevent and reduce the risk of accidents and work-related diseases (Setiono et al., 2019).

The adoption of three different approaches to managing and resolving safety concerns can help programs and efforts to develop a safety culture in work activities succeed (Sedarmayanti, 2011). The first approach is a technical one, which implies that organizations or companies can lower the rate of workplace accidents by developing technology that can

make work easier, safer, more effective, and more efficient, such as designing hardware that helps protect workers from danger. The second approach is a systemic one that emphasizes developing the ability and competence of workers through training, education, risk assessment, and the implementation of an occupational health and safety management system (Hudson, 2007).

Despite the fact that the present approach is considered capable of decreasing potential dangers in a company, workplace accidents nevertheless happen often, even when the company has good technology and systems. Therefore, the cultural approach, which places a strong emphasis on leadership and work safety-related attitudes, is needed as a third approach to work safety efforts (Vongvitayapirom et al., 2013; Lingard et al., 2014).

According to the findings of earlier research on safety culture, there is a significant correlation between safety culture and safety performance in various industrial fields. However, there is still a limited understanding of the status and level of safety culture in relation to the specific needs for developing a safety culture. Therefore, various forms of the concept of maturity are used to measure the maturity level of a company's work safety, in which the maturity concept has the ability to measure and assess actual conditions in line with the identification and development needs of the company (Tappura et al., 2022).

The Safety, Health, and Environment Management Maturity Model (iSHE-CMM), developed for construction companies, is a maturity model that was developed as a means for those companies to systematically evaluate their occupational health and safety management capabilities. The model includes five thematic scales that may be used to assess maturity (Asah-Kissiedu et al., 2021). There are five levels that may be employed to assess the level of safety culture, which were categorized into pathological, reactive, calculative, proactive, and generative levels (Hudson, 2007).

Further research in the construction industry revealed statistical findings indicating leadership, competence, and work environment had an impact on safety culture, which in turn had an impact on the level of job satisfaction in the industry. The implication of this study is that it serves as a reference model for implementing safety culture management in the construction industry to achieve job satisfaction by considering leadership, work environment, and employee competence factors (Hutajulu et al., 2021).

The working area of limited liability company national electricity company project management center–construction management implementation unit IV, further referred to as national electricity company pusat manajemen project management center – construction management implementation unit IV, has been investigated in the initial study. It was

discovered that the company has successfully implemented technical and systematic approaches, but the cultural approach has not been optimal enough, and ignorance of and disregard for occupational health and safety related aspects are issues that need to be addressed. Weak sanctions due to violations of the application of occupational health and safety aspects in carrying out work will cause workers to lose their concern about occupational health and safety aspects and disregard the culture of working safely and securely, leading to the perception that accidents are events or risks that may happen while performing work.

The aforementioned explanation emphasized the importance of implementing occupational health and safety using a safety culture approach and assessing a company's safety culture maturity level. In addition, this study aimed to determine the impact of leadership and communication on the safety culture maturity level at National Electricity Company Project Management Center – Construction Management Implementation Unit.

METHODS

The type of research used in this study is a quantitative study with a cross-sectional research design, taking measurements at one time. The research will be carried out at the limited liability company national electricity company project management center - construction management implementation unit IV which operates in the field of construction management services. The research was conducted from March to August 2023.

The selection of research samples was carried out using a total sampling approach, where this approach takes the entire population to be used as a sample. The sample for this study was taken from a population that met the inclusion and exclusion criteria, and therefore the number of samples in the study that met the criteria was 71 people.

The inclusion criteria for this research sample are all company employees with organic employee status, outsourced staff and project bases and project assignment locations that have hazard characteristics and work risk levels. Meanwhile, the exclusion criteria for the research sample are all company employees with organic employee status, outsourced staff and project base, but who work in the secretariat, finance, security, cleaning service or general sector, are assigned to projects with hazards and levels of work risk but do not carry out work. in the project directly and have a managerial or structural position in the company.

The dependent variable in this research is safety culture, while the independent variables in this research are leadership; management commitment; implementation of hazard identification, assessment and control of hazards; competence; communication; and

organizational learning. Data collection in the research used a questionnaire adopted from previous studies.

Analysis of research data using univariate analysis aims to explain and describe the characteristics of each research variable in the form of frequency distribution and average values which are then converted into categorization of safety culture maturity levels. And using analytical methods SEM-PLS (Partial Least Square-Structural Equation Model). In general, there are two types known Structural Equation Model (SEM), is Covariance-Based Structural Equation Modelling (CB-SEM) dan Partial Least Square Structural Equation Model (PLS-SEM) to analyze relationships and dominant factors that influence using software SmartPLS. In addition, this study received ethical approval from the Health Research Ethics Committee of the University of North Sumatra under number 827/KEPK/USU/2023.

RESULTS

Characteristics of Respondents

The research was conducted in the working area of Limited liability company National Electricity Company Pusat Manajemen Proyek – Unit Pelaksana Manajemen Konstruksi IV , which is one of the supporting units under National Electricity Company. This company engages in construction management services, and among its duties and functions are project control, construction supervision, and quality assurance of goods and services. Furthermore, a questionnaire was employed in this study, and data were obtained from 71 respondents who complied with the inclusion and exclusion criteria of the study. The data is presented in Table 1 as follows:

Table 1. Distribution of Respondent Characteristics

Characteristics	n	%
Gender		
Woman	12	16.9
Man	59	83.1
Age		
20–30 years	28	395
31–40 years	37	52.1
41–50 years	5	7.0
51–60 years	1	1.4
Years of Service		
<5 years	25	35.2
5–10 years	35	49.3
> 5 years	11	15.5

Table 1 shows that men, who made up 59 of the respondents (83.1%), dominated the characteristics of respondents based on gender, whereas women made up a total of 12

respondents (16.9%). According to age characteristics, the majority of respondents—37 respondents, or 52.1%—were between the ages of 31 and 40; the next-largest age group, including 28 respondents, or 39.5%; and respondents between the ages of 20 and 50, comprising 5 respondents, or 7.0%.

The frequency distribution of respondents based on years of service revealed that the majority of respondents were in the category of 5–10 years of service, which was 35 respondents (49.3%). In addition, there were 25 respondents (35.2%) with less than five years of service, and there were 11 respondents (15.5%) with more than five years of service.

Normality Test

Based on the results of the data testing analysis for the normality assumption, a Kolmogorov-Smirnov significance value of 0.200 was obtained, which was greater than 0.05, indicating that the research data was normally distributed.

Multicollinearity Assumption Test

The multicollinearity assumption test for the research data is presented as follows:

Table 2. Multicollinearity Assumption Test

Variables	Variance inflation factor	Explanation
Leadership	1.439	Non Multicollinearity
Communication	1.439	Non Multicollinearity

Table 2 shows that the tested variables had variance inflation facto values <10, indicating that the independent variables did not contain multicollinearity or non-multicollinearity. It implies that leadership and communication had no correlation to each other and were appropriate to be used as independent variables in this study.

Heteroscedasticity Assumption Test

The results of data testing on the research variables are presented as follows:

Table 3. Heteroscedasticity Assumption Test

Variables	Sig.	Explanation
Leadership	0.166	Non Heteroscedasticity
Communication	0.629	Non Heteroscedasticity

Table 3 provides evidence that the leadership and communication variables under investigation did not contain heteroscedasticity, with significance values of 0.166 and 0.627, respectively.

Multiple Linear Regression Analysis Test

According to Table 4, the results of the leadership variable test on the safety culture maturity level had a t count (5.040) > t table (1.995) and a significance value or p value < 0.05,

indicating that the leadership variable had a significant impact on the safety culture maturity level. The communication variable experienced the same thing, with test results showing a t count (7.031) < t table (1.995) and a significance value or p value < 0.05, indicating that communication had a significant impact on the company's safety culture maturity level.

Table 4. Results of Multiple Linear Regression Analysis

Variables	t_{count}	t_{table}	*p value*	Explanation
Leadership	5.040	1.995	0.0001	had a significant impact
Communication	7.031	1.995	0.0001	had a significant impact

According to the results of the data analysis, simultaneous test results were obtained, which were conducted to determine the impact of leadership and communication variables concurrently (simultaneously) on the safety culture maturity level. The results of the test demonstrated that, with a significance level < 0.05, f count (81.98) > f table (3.13), indicating that the leadership and communication factors had a simultaneous impact on the safety culture maturity level.

The resulting multiple linear regression equation model was elaborated as follows:

$$Y= -11.614 + 5.040\ X_1 + 7.031\ X_2$$

In the equation elaborated, Y denotes the safety culture maturity level, X_1 denotes the leadership variable, and X_2 denotes the communication variable.

The coefficient of determination obtained from the results of multiple linear regression tests demonstrated how much the leadership and communication variables could have an impact on the maturity of the safety culture. The coefficient of determination was 0.707, indicating that there was a positive correlation between leadership and communication on the maturity of safety culture and a combined impact of 70.7%.

DISCUSSION

The Impact of Leadership on Safety Culture Maturity Level

The intended objective of an optimal safety culture is to prevent workers from acting unsafely at work, and working conditions will always be made as safe and suitable as possible for workers. This will help suppress the number of work-related accidents and diseases to even naught. Moreover, a study showed that a good safety culture would lead to a decline in unsafe worker behavior (Bilqis et al., 2021).

In addition, studies conducted in the mining industry demonstrated a negative correlation between the incidence of work accidents and the maturity level of the safety culture. A low safety culture maturity value was observed in mines with a high number of work

accidents, whereas a high safety culture maturity value was observed in mines with fewer accidents (Stemn et al., 2019).

Leadership in safety involves transforming work teams by creating, delivering, and modeling work units that inspire workers. In light of this, the prior study concluded that leadership is one of the determinants impacting safety culture (Rahman et al., 2021). According to the findings of this study conducted at National Electric Company Project Management Center–Construction Management Implementation Unit IV, leadership aspects in the company had a significant impact on the implementation of the safety culture maturity level. The influence of the two was unidirectional, suggesting that the higher and better the leadership in a company, the higher the maturity level of the company's safety culture.

This is in line with research conducted at a container management company, which found that leadership had a significant impact on safety culture. Thus, if the leadership at a company is good, a better safety culture may be developed (Atikasari et al., 2022).

Leadership characteristics such as the ability to motivate and inspire workers can make them aware of the importance of safety at work. As a result, they will endeavor to enhance work safety by following safety regulations and contributing to the company's work safety improvement (Puruboyo et al., 2023).

The Impact of Communication on Safety Culture Maturity Level

According to the results of previous research, leadership was a significant factor that had a statistically significant impact on safety culture, while communication aspects had no impact (Hutajulu et al., 2021). This occurred because communication had a relatively weak correlation with safety culture maturity (Liana et al., 2022).

Moreover, occupational health and safety culture was dominantly influenced by perceptions of communication in the implementation of occupational health and safety, while cultural perceptions of occupational health and safety itself had a significant relationship with safety culture maturity level (Nur Afifah et al., 2018).

In addition, previous research also explained that communication is one of the factors that have an impact on the development of a safety culture, while others are in the form of management commitment, employee involvement, knowledge, competence, compliance, and behavior (Stevianingrum et al., 2022). Thus, it was concluded that one of the factors that had a correlation with safety was communication (Yasmi et al., 2018).

The communication aspect of this study demonstrated that there was a significant, unidirectional impact of communication on the maturity level of the safety culture. This implies that if the communication that is built between management, staff, and workers is optimal, then

the level of maturity of the company's safety culture will also be good and optimal. As explained in a study on private companies that manage power plants, the better the communication that is fostered, the more optimal the performance of employees in carrying out their duties (Rahman et al., 2021).

Furthermore, the characteristics of hospitals with a good safety culture were described as having good internal communication built on mutual trust, sharing the same perspective on the relevance of safety, and trusting in the effectiveness of preventative measures (Palendeng et al., 2022).

Additionally, according to research on upstream oil and gas companies in South Sumatra Province, occupational health and safety communication was the aspect that had the most impact on safety culture behavior among the workers (Andi Palancoi, 2014). Moreover, this study is in line with the research on a construction project for the construction of a railroad power substation, which explained that occupational health and safety communication had an impact on safety culture (Muafiq et al., 2021).

The results of observation and analysis of prior research led to the conclusion that communication in workplaces or companies could improve unsafe behavior and unsafe conditions, foster discussion about behavior and safe working conditions, and prioritize observations based on the level of risk so that corrective actions can be determined from the outcomes of work safety observations (Sulistyo P, 2020).

Several forms of OSH communication that may be carried out include the conduct of safety talks and safety briefings prior to the commencement of work. Another aspect of Occupational Health and Safety communication in the workplace is the use of posters or banners with safety-related messages. Regular monthly meetings like the occupational safety and health advisory committee routine meeting, socialization of work procedures, safety meetings, and the implementation of routine occupational health and safety educational activities can also foster two-way communication between management and employees, fostering awareness of implementing a safety culture. In addition, reducing the power disparity between management and staff or employees is frequently the focus of efforts to enhance safety-related practices since it improves communication processes (Tear et al., 2020).

Moreover, increasing the safety of coworkers within the culture is a key strategy for developing a positive safety culture. This may be accomplished through effective communication and the sharing of safety information between employees (Zhang et al., 2020).

According to the results of the research and the theory discussed above, leadership and communication were partially able to have a significant impact on the maturity level of safety

culture. Together or simultaneously, they could have a greater impact on the maturity level of safety culture. Moreover, the impact of leadership and communication on fostering a culture of safety in health nursing teams was highlighted in research conducted in workplaces like hospitals, which also performed evaluations to measure and improve safety culture (O'Donovan et al., 2019).

Furthermore, the impact of communication and leadership on safety culture maturity was also revealed by research in Tenggarong (Silalahi et al., 2019). Another study conducted in Poland in the energy sector revealed that communication and leadership were able to encourage companies to autonomously achieve the highest level of safety culture maturity (Siuta et al., 2022).

It can be concluded from the presentation of the findings and the discussion that, at National Electric Company Project Management Center–Construction Management Implementation Unit IV, aspects of leadership and communication had a significant impact on the level of maturity or safety culture maturity in the workplace.

CONCLUSIONS

According to the description of the research's results and the discussion of the influence of leadership and communication on the maturity level of safety culture, it can be concluded that leadership had a significant impact on the level of maturity of safety culture partially (p value <0.05) and communication also had a significant impact on the level of maturity of safety culture partially (p value <0.05). In addition, leadership and communication simultaneously had an impact on the safety culture maturity level of 70.7%, whereas other variables or aspects that were not examined in this study had an impact of 29.3%.

It is recommended to make a commitment to occupational safety and health that is not only for company management, but a commitment that covers and is understood by all workers as well as consistent management encouragement in implementing occupational safety and health to realize a shared commitment.

To carry out occupational safety and health education and training that is tailored to the identification of job hazards and risks to then be analyzed and compiled into a training needs plan or training needs analysis so that employee competency development needs can be clearly mapped and implemented based on the job risks they have.

Furthermore, it is recommended that workers, in accordance with the results of this research, be able to consistently take part and be involved in implementing work safety culture in the company and proactively provide input that is able to build a resilient work safety culture,

because basically workers are the ones who know best the actual situation and conditions of the workplace.

REFERENCE

Andi Palancoi, N. (2014). Determinan Budaya Keselamatan Pada Pekerja Hulu Minyak Dan Gas. *Jurnal Kesehatan*, *7*(2), 346–352.

Asah-Kissiedu, M., Manu, P., Booth, C. A., Mahamadu, A.-M., & Agyekum, K. (2021). An Integrated Safety, Health and Environmental Management Capability Maturity Model for Construction Organisations: A Case Study in Ghana. *Buildings*, *11*(645), 1–28. https://doi.org/10.3390/buildings11120645

Atikasari, C. D., Sudiarno, A., & Priyanto, E. (2022). The effect of safety leadership, safety culture, and safety behavior on safety performance after a company merger: a case study. *Jurnal Sistem Dan Manajemen Industri*, *6*(2), 187–199. https://doi.org/10.30656/jsmi.v6i2.5051

Bilqis, K., Sultan, M., & Ramdan, I. M. (2021). Hubungan antara Budaya Kesehatan dan Keselamatan Kerja (K3) dengan Perilaku Tidak Aman Pekerja Konstruksi di PT. X Kabupaten Kutai Kartanegara. *Jurnal Kesehatan Masyarakat Mulawarman (JKMM)*, *3*(1), 19. https://doi.org/10.30872/jkmm.v3i1.6271

Hudson, P. (2007). Implementing a safety culture in a major. *Safety Science*, *45*, 697–722. https://doi.org/10.1016/j.ssci.2007.04.005

Hutajulu, R. S., Susita, D., Usman, O., & Eliyana, A. (2021). Factors of Safety Culture and their Implication to Job Satisfaction in the Construction Industry. *GATR Global Journal of Business Social Sciences Review*, *9*(2), 174–181. https://doi.org/10.35609/gjbssr.2021.9.2(7)

Liana, D., Lestari, F., Sutoto, S., Modjo, R., & Bachtiar, A. (2022). *A self-assessment model for hospital safety culture maturity m er ci al us e on er al*. *11*, 51–58.

Lingard, H., Zhang, R. P., Harley, J., Blismas, N., & Wakefield, R. (2014). *Health and Safety Culture* (Issue August). RMIT University.

Muafiq, R., Putra, I. N. D. P., & Rumintang, A. (2021). Pengaruh Budaya Keselamatan Dan Kesehatan Kerja (K3) Terhadap Kinerja Proyek Konstruksi. *Teknik Sipil Dan Teknologi Konstruksi*, *7*(1), 27–39. https://doi.org/10.35308/jts-utu.v7i1.3031

Nur Afifah, A., & Hadi, S. (2018). Analisis Budaya K3 dengan Nordic Occupational Safety Climate Questionnaire dan Safety Culture Maturity Model. *Jurnal Fakultas Kesehatan Masyarakat*, *12*(2), 113–119.

O'Donovan, R., Ward, M., De Brún, A., & McAuliffe, E. (2019). Safety culture in health care teams: A narrative review of the literature. In *Journal of Nursing Management* (Vol. 27, Issue 5). https://doi.org/10.1111/jonm.12740

Palendeng, F. O., & Bernarto, I. (2022). Pengaruh Iklim Keselamatan, Sistem Manajemen Keselamatan, Dan Perilaku Keselamatan Terhadap Budaya Keselamatan Staf Klinis Di Rs Gunung Maria. *JMBI UNSRAT (Jurnal Ilmiah Manajemen Bisnis Dan Inovasi Universitas Sam Ratulangi).*, *9*(3), 1599–1616. https://doi.org/10.35794/jmbi.v9i3.44511

Puruboyo, S., & Djunaidi, Z. (2023). *Analisis tingkat kematangan budaya keselamatan kerja pada proyek konstruksi migas nasional*. *7*(April), 141–148.

Rahman, R., Thamrin, Y., & Batara, A. S. (2021). Analisis Faktor Determinan Budaya Keselamatan dan Kesehatan Kerja di PT.Energi Sengkang. *An Idea Health Journal*, *1*(1), 54–61. https://doi.org/10.53690/ihj.v1i1.28

Sedarmayanti. (2011). *Tata kerja dan produktivitas kerja: suatu tinjauan dari aspek ergonomi atau kaitan antara manusia dengan lingkungan kerjanya*. Mandar Maju.

Setiono, B. A., & Andjarwati, T. (2019). *Budaya Keselamatan, Kepemimpinan Keselamatan, Pelatihan Keselamatan, Iklim Keselamatan dan Kinerja*. Jakarta : Zifatama Jawara.

Silalahi, M., Rivai, F., & Amiruddin, R. (2019). Pengaruh Faktor Organisasi Terhadap Maturitas Budaya Keselamatan Pasien Di Rumah Sakit a.M Parikesit Tenggarong Tahun 2017. *Jurnal Kesehatan Masyarakat Maritim*, *1*(1), 22–30. https://doi.org/10.30597/jkmm.v1i1.8692

Siuta, D., Kukfisz, B., Kuczyńska, A., & Mitkowski, P. T. (2022). Methodology for the Determination of a Process Safety Culture Index and Safety Culture Maturity Level in Industries. *International Journal of Environmental Research and Public Health*, *19*(5). https://doi.org/10.3390/ijerph19052668

Stemn, E., Bo, C., Cli, D., & Hassall, M. E. (2019). Examining the relationship between safety culture maturity and safety performance of the mining industry. *Safety Science*, *113*(December 2018), 345–355. https://doi.org/10.1016/j.ssci.2018.12.008

Stevianingrum, A., & Erwandi, D. (2022). Faktor-Faktor Dominan Budaya Keselamatan Di Sektor Tambang Batubara : Kajian Literatur. *PREPOTIF : Jurnal Kesehatan Masyarakat*, *6*(2), 1018–1026. https://doi.org/10.31004/prepotif.v6i2.4177

Sulistyo P, B. (2020). Strategi Komunikasi dalam membentuk Budaya Keselamatan kerja melalui Implementasi Observasi PEKA (Pengamatan Keselamatan Kerja) di PT. X. *Jurnal Kajian Ilmiah*, *20*(1), 1–12. https://doi.org/10.31599/jki.v20i1.66

Tappura, S., Jääskeläinen, A., & Pirhonen, J. (2022). Creation of satisfactory safety culture by developing its key dimensions. *Safety Science*, *154*(April). https://doi.org/10.1016/j.ssci.2022.105849

Tear, M. J., Reader, T. W., Shorrock, S., & Kirwan, B. (2020). Safety culture and power: Interactions between perceptions of safety culture, organisational hierarchy, and national culture. *Safety Science*, *121*(March), 550–561. https://doi.org/10.1016/j.ssci.2018.10.014

Vongvitayapirom, B., Sachakamol, P., Kropsu-Vehkaperä, H., & Kess, P. (2013). Lessons Learned from Applying Safety Culture Maturity Model in Thailand. *International Journal of Synergy and Research*, *2*(1), 5–21.

Wardhani, M. O. (2017). *Implementasi Sistem Manajemen Kesehatan dan Keselamatan Kerja (SMK3) Pada Perusahaan Daerah Air Minum Kota Malang*. http://etheses.uin-malang.ac.id/10464/1/10510137.pdf

Yasmi, Y., & Thabrany, H. (2018). Faktor-Faktor Yang Berhubungan Dengan Budaya Keselamatan Pasien Di Rumah Sakit Karya Bhakti Pratiwi Bogor Tahun 2015. *Jurnal Administrasi Rumah Sakit Indonesia*, *4*(2), 98–109. https://doi.org/10.7454/arsi.v4i2.2563

Zhang, J., Fu, J., Hao, H., Fu, G., Nie, F., & Zhang, W. (2020). Root causes of coal mine accidents: Characteristics of safety culture deficiencies based on accident statistics. *Process Safety and Environmental Protection*, *136*, 78–91. https://doi.org/10.1016/j.psep.2020.01.024